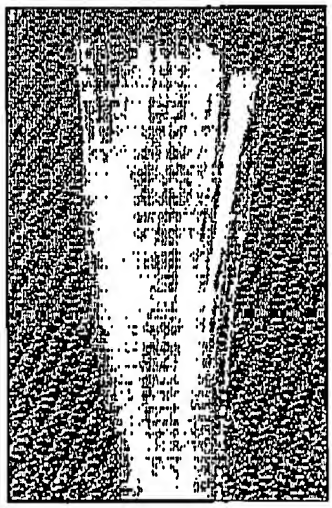
GLASS FIBER REINFORCED PLASTIC

Composite materials (or **composites** for short) are engineered materials made from two or more constituent materials that remain separate and distinct on a macroscopic level while forming a single component.

There are two categories of constituent materials: matrix and reinforcement. At least one portion (fraction) of each type is required. The matrix material surrounds and supports the reinforcement materials by maintaining their relative positions. The reinforcements impart special physical (mechanical and electrical) properties to enhance the matrix properties. A synergism produces material properties unavailable from naturally occurring materials. Due to the wide variety of matrix and reinforcement materials available, the design potential is incredible.



instead of, or in addition to, fibers.

In terms of stress, any fibers serve to resist tension, the matrix serves to resist shear, and all materials present serve to resist compression, including any aggregate. Composite materials can be divided into two main categories normally referred to as short fiber reinforced materials and continuous fiber reinforced materials. Continuous reinforced materials will often constitute a layered or laminated structure.

CARBON FIBER

Carbon fiber can refer to carbon filament thread, or to felt or woven cloth made from those carbon filaments. By extension, it is also used informally to mean any composite material made with carbon filament. It is a strong and very expensive material.

Synthesis

Each carbon filament is made out of long, thin sheets of carbon similar to graphite. A common method of making carbon filaments is the oxidation and thermal pyrolysis of polyacrylonitrile (PAN), a polymer used in the creation of many synthetic materials. Like all polymers, polyacrylonitrile molecules are long chains, which are aligned in the process of drawing fibres. When heated in the correct fashion, these chains bond side-to-side, forming narrow graphene sheets which eventually merge to form a single, jelly roll-shaped filament. The result is usually 93-95% carbon. Lower-quality fiber can be manufactured using pitch or rayon as the precursor instead of PAN. The carbon can become further enhanced, as high modulus, or high strength carbon, by heat treatment processes. Carbon heated in the range of

1500-2000°C (carburizing) exhibits the highest tensile strength (820,000 Psi or 5,650 N/mm²), while carbon fiber heated from 2500-3000°C (graphitizing) exhibits a higher modulus of elasticity (77,000,000 Psi or 531 kN/mm²).

Textile

These filaments are stranded into a thread. Carbon fiber thread is rated by the number of filaments per thread, in thousands. For example, 3K (3,000 filament) carbon fiber is 3 times as strong as 1K carbon fiber, but is also 3 times as heavy. This thread can then be used to weave a carbon fiber cloth. The appearance of this cloth generally depends on the size of thread and the weave chosen. Carbon fiber is naturally a glossy black but recently colored carbon fiber has become available.

Uses

Carbon fiber is most notably used to reinforce composite materials, particularly the class of materials known as graphite reinforced plastic. This class of materials is used in high-performance vehicles, sporting equipment, and other demanding mechanical applications; a more thorough discussion of these uses, including composite lay-up techniques, can be found in the carbon fiber composite article.

Non-polymer materials can also be used as the matrix for carbon fibres. Due to the formation of metal carbides (i.e., water-soluble AlC) and corrosion considerations, carbon has seen limited success in metal matrix composite applications. Reinforced carbon-carbon (RCC) consists of carbon fibre-reinforced graphite, and is used structurally in high-temperature applications, such as the nose cone and leading edges of the space shuttle.

The fibre also finds use in filtration of high-temperature gases, as an electrode with high surface area and